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self to death against the iron. Both shoulder blades and one coracoid were broken; the other coracoid was dislocated; there was a double fracture of the merry-thought, and a crack in the keel of the breastbone; while all the muscles of the breast were terribly bruised, and full of blood-clots.

REVIEWS.

HUXLEY'S CLASSIFICATION OF ANIMALS. *Continued from Page* 546.— Professor Huxley very clearly sets forth the characteristics of the group, or Subkingdom, of VERTEBRATA, and as plainly indicates the three Provinces into which it is divisible, viz: I. The ICHTHYOPSIDA, comprising the Fishes and Amphibians; II. The SAUROPSIDA, comprising the Reptiles and Birds; III. The MAMMALIA. These three groups are certainly well marked, and the affinities of their members have for a long time been noticed and agreed to. No one can doubt the close relationship existing between the Fishes and Amphibians (Salamanders, Frogs, etc.,); and since the discovery of the remarkable fossil form of *Archæopteryx*, which has been placed alternately in the classes of Reptiles and Birds, the characters of these two classes have been so thoroughly sifted as to prove their close affinity; neither can the distinctive characters of the class of Mammalia be questioned, though as has often been pointed out, and as Prof. Huxley also insists upon, the Mammals, Birds and Reptiles, or the *Abranchiate Vertebrata*, have certain characteristics in common, distinguishing them from the equally well defined group of Amphibians and Fishes, or the *Branchiate Vertebrata.*

In adopting M. de Blainville's three primary divisions of the Mammalia, as characterized by the reproductive organs, especially those of the female, Prof. Huxley states that he does "not mean to assert that M. de Blainville defined these different groups in a manner altogether satisfactory, or strictly in accordance with all the subsequently discovered facts of science, but his great knowledge and acute intuition led him to perceive that the groups thus named were truly natural divisions of the Mammalia. And the enlargement of our knowledge by subsequent investigation seems to me, in the main, only to have confirmed De Blainville's views." These primary divisions, or subclasses, are the *Ornithodelphia*, containing only the genera Ornithorhynchus and Echidna; the *Didelphia*, or the Marsupials; and the *Monodelphia*, embracing all the rest of the orders of the class, which, from "placental" characters, he places in five groups. Without either endorsing or attempting to disprove Prof. Huxley's views in relation to the special classification of the Mammalia, we will simply compare the results of his system with those of the equally carefully considered one of Owen published ten years before. Both are strictly anatomical and confined (so far as tabulating the results are concerned) to one set of organs: Owen taking the modifications of the brain; Huxley the generative organs, or more especially the uterus and the placenta in connection with the development of the embryo.

Owen divides the Mammalia into *four* subclasses; Huxley into *three.*

Owen's first three subclasses (the *Archencephala,* — Man; the *Gyrencephala,* — Ape, Lemur, Dog, Bear, Seal, Hog, Sheep, Horse, Tapir, Elephant, Manatee, Whale, etc.; and the *Lissencephala,* — Sloth, Armadillo, Anteater, Bat, Mole, Hedgehog, Shew, Hare, Rat, etc.) are contained in Huxley's subclass *Monodelphia.*

Owen's fourth subclass (*Lyencephala,*—the Marsupials, and Echidna and Ornithorhynchus) is divided into two subclasses by Huxley, corresponding to the two *orders* of Owen, viz: subclass *Didelphia* of Huxley=order Marsupialia of Owen; and subclass *Ornithodelphia* of Huxley=order Monotremata of Owen.

The result of this comparison of two anatomical systems is favorable to the generally received orders of the class being established on firm grounds, for, with the exceptions following in parenthesis, both Huxley and Owen, though investigating from different stand points, have kept the orders intact, and have only changed the order of their relation, or succession, in accordance with the views each has taken regarding the value of groups more comprehensive than orders. (Man is considered by Owen as differing from all other Mammals in the cerebral character, and hence considered as a subclass; while Huxley, from the identity of the placenta with that of the Apes, Lemurs, Insectivora, Chiroptera and Rodentia, unites him with them in the group of Monodelphia with a *discoidal deciduate placenta,* but retains him as a suborder of the order of PRIMATES, which contains two other suborders, the *Apes* and the *Lemurs,* corresponding to Owen's order of Quadrumana. Huxley unites Owen's orders Perissodactyla and Artiodactyla — containing together the Tapir, Horse, Sheep, Hog, etc. — as two suborders under his order of UNGULATA, which, with the Cetacea, are united in a group characterized by the *non-deciduate placenta.* Huxley considers the genus *Hyrax* as the sole representative of a distinct order, removed to the next group, with the Proboscidia and Carnivora, having a *zonary deciduate placenta*).

After noticing the results of this hasty comparison, may we not ask why the character of the brain (provided the results are well founded by examination in such a manner as to leave no doubt of their correctness) should not be as good a guide as the anatomical structure of the uterus and placenta? It has been stated that in some respects the Cerebral system is liable to lead to errors. On the other hand, we read in Huxley's work that there is doubt as to the real position that some of the animals should hold in his system, on account of the very character he has taken for the basis of his classification not being known in some, and in others liable to be differently understood, and he admits (p. 72) that the placenta, the peculiar character of which he takes for his guide in defining the five groups of the Monodelphia, is "a structure not universally characteristic of the class." With these exceptions and gaps taken into account, in addition to the limitation of the placental characters to one sex, is not the Cerebral system as likely to lead to a natural grouping of the orders of Mammalia as one based on the reproductive organs?

From what we have stated it must not be supposed, by those who have not yet read Prof. Huxley's invaluable résumé of the classification of the Mammalia, that the author has confined himself to considerations resulting from the study of the reproductive organs, for, on the contrary, while their peculiar structure, and the development of the embryo and its relation to the parent, forms the basis of his division of the class into three subclasses, and the structure of the placenta that of the five secondary groups of the principal subclass; he also gives other characters common to each group, and in his summary of the orders he brings together their principal structural elements, and discusses their relations from other stand points, for an understanding of which we must refer the reader to the work itself.

Without farther comments—other than to state that it is our belief that the orders of the birds will require farther confirmation before they are generally adopted by ornithologists, and remarking that the orders of the Reptilia and Amphibia are mainly those now commonly received—we give the groupings of his second Province, the SAUROPSIDA.

Class I. BIRDS (*Aves*), he divides into three orders:—(1) SAURURÆ, containing only the extinct form, *Archæopteryx;* (2) RATITÆ, containing the Ostriches, Emeus, Apteryx, etc.; (3) CARINATÆ, containing all the ordinary birds.

Class II. REPTILES (*Reptilia*), he divides into four orders of living and five of fossil forms:—(1) CROCODILIA (Crocodiles, Alligators, and their allies); (2) LACERTILIA (Lizards, Blindworms and Chameleons); (3) OPHIDIA (the Snakes); (4) CHELONIA (the Turtles and Tortoises). The five orders represented only by fossils are the ICHTHYOSAURIA, the PLESIOSAURIA, the DICYNODONTIA, the PTEROSAURIA and the DINOSAURIA.

The third Province, the ICHTHYOPSIDA, containing the classes of Amphibians and Fishes, is arranged as follows:—

Class I. AMPHIBIANS (*Amphibia*). Four orders:—(1) URODELA (the Newts, Salamanders, Sirens, etc.); (2) BATRACHIA (the Frogs and Toads); (3) GYMNOPHIONA (the Cæcilians, etc.); (4) LABYRINTHODONTA (fossil forms).

Class II. FISHES (*Pisces*). Six orders:—(1) DIPNOI (containing only the singular "Mud fishes," *Lepidosiren* and *Rhinocryptis*); (2) ELASMOBRANCHII (Sharks, Skates, and Chimæras); (3) GANOIDEI (Sturgeons, Garpikes, Dogfish (*Amia*), etc.); (4) TELEOSTEI (the ordinary "Bony" fishes); (5) MARSIPOBRANCHII (Lampreys, etc.); (6) PHARYNGOBRANCHII (represented by the single genus *Amphioxus*).

In this classification of fishes Prof. Huxley has simply followed the groups of Müller, given twenty-three years ago, but has lowered the rank of the groups from subclasses, as they were considered by Müller, to orders. These groups are undoubtedly well founded, but their equality of rank may be questioned. The *Dipnoi* are very Amphibian in many of their characters, and the typical *Ganoidei* are equally Reptilian in some of theirs, both agreeing, however, in much that is important in their anatomy (five out of the eleven characters assigned by Huxley to Dipnoi being common to the Ganoidei as well, and the other six characters are either of an aberrant or embryonic nature). The *Elasmobranchii* are equally an aberrant group, with affinities to the higher classes of Birds and Mammals. The *Marsipobranchii* are low, degradational, or embryonic forms, when relatively considered with the other groups of the class; and the single genus of the *Pharyngobranchii* is of so low an embryonic type that it must be considered as representing a distinct subclass, unless the embryology of the lower Marsipobranchiates shall prove it to be the lowest order of that subclass. The *Teleostei* are the most fish-like of fishes, agreeing more nearly with the Ganoidei than with the other groups. Are these six groups of equal value? and if so do they rank as subclasses or as orders? and what is the rank of the groups into which all but the Dipnoi and Pharyngobranchii are most naturally subdivided? If the same considerations used to discriminate the orders among Mammals, Reptiles, or Amphibians be applied to the fishes, will not the secondary divisions of the groups Teleostei, Elasmobranchii, Ganoidei and Marsipobranchii by force be considered as orders? On these considerations we agree with Prof. Gill, who in 1861, in a discussion of the subject of the higher groups among fishes (Proc. Philad. Acad Nat. Sci.), united the Dipnoi with the subclass of Ganoids, considering them only of equal rank with his other three orders of the subclass. The Pharyngobranchii, which Prof. Gill considers as an order of the Marsipobranchii, we keep as a distinct subclass, subject to change on farther knowledge of the embryology of the Marsipobranchiates.

Our views of the higher groups might be expressed thus:—

Class PISCES.
Typical.
Subclass TELEOSTEI.

Aberrant.
(Mammalian and Avian.)
Subclass ELASMOBRANCHII.

Aberrant.
(Reptilian and Amphibian.)
Subclass GANOIDEI.

Degradational.
Subclass MARSIPOBRANCHII.

Embryonic.
Subclass PHARYNGOBRANCHII.

We confess ourselves much disappointed in that part of the work which relates to the Mollusca. Though the general facts and special details of the anatomy are clearly stated, no notice is taken of the plan or archetypal characteristics of the branch, which were admirably defined by Carpenter in 1854, and by Dana in 1863, and Mr. Morse in 1865,* and nothing is said of the embryology of either the animals or the shells, omissions which are unpardonable in an essay on classification.

The subdivision of the branch into Mollusca and Molluscoida also appears to us objectionable. If Prof. Huxley had drawn his dividing line between the Lamellibranchs and Pteropods we should have had an eminently natural division of the Mollusca, but in placing the line between the Lamellibranchs and the Ascidians he repeats a common error.

The Polyzoa, Brachiopoda, Ascidia and Lamellibranchiata have to the Pteropoda, Gasteropoda and Cephalopoda, within their own type, a negative relation comparable to that which the invertebrata have to the vertebrata; they are, when contrasted with the last three classes, as a whole, without a special cephalized extremity. All the three higher classes have the cephalic region distinctly differentiated from the mantle, or cœnœcial region, whereas in all the lower classes the organs of this region are buried in the mantle, or cœnœcial region, except among the Polyzoa, where they are distinct from the cœnœcial region, and may be extended in the higher genera, but this differentiation is gained only by elevating the cephalic organs to the posterior pole of the body.

The close structural affinities of the Polyzoa and Brachiopoda are noticed; the two divisions are placed in their correct sequence, and their relations to the Ascidia are defined with equal precision and correctness; but the author fails to see the close affinity of the latter to the Lamellibranchiata. Nevertheless the differences between the structure of the Lamellibranchs and Ascidians are no greater than those existing between the structure of the Polyzoa and the Brachiopoda, whilst the homologies existing between the Ascidia and the Polyzoa are of a much more general character than those existing between the Ascidians and the Lamellibranchs.

The Polyzoa and Brachiopoda together may be considered as one anatomical type, and defined as a sac closed at one end by a disc, surrounded by free tentacles, and perforated by an edentulous mouth from which hangs the alimentary canal.

Among the Ascidia and Lamellibranchiata on the other hand the tentacles, or gills, are always joined by an intermediate membrane, and they together with this membrane form either an open or closed pouch perforated at its lower end by the mouth, from which hangs the alimentary canal.

The atrial chamber has but one aperture in an invaginated Polyzoön or a Brachiopod, whereas with the Ascidia and Lamellibranchiata there are two. The muscular systems of the Brachiopoda and Polyzoa are complicated and homologically similar, as shown by several writers, whereas the Ascidia have no distinct muscles which can be compared to those intersecting the visceral cavities of the Polyzoa and Brachiopoda.

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* Carpenter's Comparative Physiology, Dana's Manual of Geology, and Mr. Morse's Classification of the Mollusca in the Proceedings of the Essex Institute.

Mr E. S. Morse has lately shown (September number of the NATURALIST) that the closest resemblance exists between the young of Terebratula and the adult Polyzoön, so close that there would be no hesitation in placing them in the same class, if the characteristics of the former were permanent.

In fact we cannot coincide with those who consider that the principles of the Cuvierian classification are endangered by Mr. Huxley's book. While no champion of all of Cuvier's principles, we cannot but regard any work which wholly sets them aside as very deficient in comprehensiveness; it must necessarily substitute a multitude of details for the very general anatomical statements by which four out of the five great branches of the animal kingdom are usually defined.

THE SHEFFIELD SCIENTIFIC SCHOOL.*—Prof. Verrill reports that the want of funds in the Zoölogical department has prevented the usual increase of specimens, but that the time has been turned to good account in cataloguing and classifying the general collection, and writing monographs of separate groups. Mr. S. I. Smith has monographed a part of the Decapods, and Prof. Verrill the Polyps and Corals of the west coast of America, and described numerous new forms.

The Geological department, under the direction of Prof. O. C. Marsh, has received several very valuable additions. Among these the most remarkable is a slab with twenty-one footprints of the Otozoum upon it, each of which is about fifteen inches in length. The slab is of a correspondingly gigantic size, measuring twenty by thirty feet.

We have not space to review other departments, but regret to notice that all of them seem to be laboring under pecuniary difficulties.

At Yale we really have a Scientific School, one which gives young men a general knowledge of science and the arts as well as a more intimate acquaintance with some special branch.

The advantages presented by the school in its mode of organization, its corps of instructors and the objects which it seeks to attain for all its students, are of the highest order. We hope, therefore, that the pecuniary hindrances to the future progress of an institution, so important to the general interests of education in this country, may be speedily removed.

NEW ECHINODERMS AND CORALS.†—In this paper Prof. Verrill describes seven new species of Echinoids, five of Asterioids, six of Ophiuroids, and six new species of coral, with one new genus among the Eupsammidæ.

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* Fourth Annual Report of the Sheffield Scientific School of Yale College, pamph., 8vo, 76 pp. New Haven, 1869.

† On New and Imperfectly Known Echinoderms and Corals. By A. E. Verrill. Ext. Proc. Bost. Soc. Nat. Hist., Vol. xii, pp. 382-'96.